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ABSTRACT

The methods course presently in operation at Pennyslvania State University is organized around the achievement of performance criteria following a mastery learning model. Although conditions for demonstrating competency are specified by the instructors, students select the means for developing the competencies and follow their own schedule by completing formal learning contracts. This arrangement is called Structured Independent Study. The most exacting requirement demands that the student videotape, code, and critique two teaching performances in terms of prescribed teaching behaviors. Coding is accomplished with the Social Substantive Schedule, which assesses the congruence between a specified instructional mode and a teacher's verbal behavior. Preliminary results from comparing students in the experimental course with students in a traditional course indicate that although typical measures of course achievement did not discriminate between groups, experimental students spent significantly less time on the course and conferred with the instructor significantly more often than traditional students. Students rated the videotape evaluation as the most valuable course activity. (RT)

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# AN EXPERIMENTAL SCIENCE METHODS COURSE; SIMULATION OF REALISTIC CLASSROOM FUNCTIONS

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## Introduction

Among other attributes, a professional is a person who engages in behaviors which are witting and deliberate, based on a rationale, and monitored to their purported effort. This paper reports the rationale for and structure of a science methods course designed to prepare prospective teachers to meet the behavior-oriented definition just cited.

Whenever criticisms are levelled at any profession, the acceptance of those criticisms usually rests upon the degree to which the comments are constructive and cannot hope for future endeavors. Let us examine some of the more constructive criticisms of teacher education to set the stage for the experimental methods course to be described later.

Walter Borg (1970) and others of the Far West Regional Educational Research Laboratory suggested:

> ... that most current programs are seriously deficient with regard to building the specific skills and behavior patterns the teacher needs to structure efficiently a variety of classroom teaching-learning situations (page 23).

Mr. Borg further suggested that teacher education institutions have generally suffered from the four "serious deficiencies" of

(1) emphasis on telling instead of doing

(2) instruction in general, rather than specific

(3) lack of effective models of teacher behavior

(4) lack of effective feedback.

Although the preceding comments were made to justify the teacher skills training

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courses Mr. Borg and colleagues are developing, it seems that he has much to say to those institutions providing preparatory programs for teaching.

Certain problems appear in the field, possibly as a result of the weaknesses cited above, but certainly a product of teacher education generally. For example, in spite of the recent emphases on inductive teaching methods such as guided discovery and inquiry in science education, there is evidence to suggest virtually no differences in the questioning patterns of today's teachers 50 years ago (Borg, 1970).

In the Handbook of Research on Teaching, Gage (1963) stated that the use of operational definitions of specific skills of teaching is a marked advance over the typical strategy, used for over a half century, of studying teaching in terms of vague, nonoperational criteria. F. J. MacDonald, in a 1969 paper addressed to the American Educational Research Association, put forth the view that to develop effective teaching skills, a program must meet the following three major requirements:

(1) the learner must be provided a very clear definition of the specific skills he is to master

(2) he must have opportunity to practice these skills, preferably under less demanding conditions than those found in full class teaching situations

(3) he must receive specific feedback on his practice that will help him bring his performance close to the model or definition.

Rationale for the Course

Considerable interest has been shown in the past year regarding the function of the methods course. For example methods instructors are charged by Voelker (1970) to practice what they preach. What appears to be needed are (1) analyses of demands being placed on teachers in their teaching assignments, (2) appropriate preprofessional experiences to create competencies that have the potential for meeting those demands, and (3) the incorporation of feedback from research

studies and student teacher supervisors for increasing the viability of the course. Instructors of methods courses are being asked, to the extent possible, to provide preservice classroom reality. The task then is one of simulation "... the creation of an artificial environment that resembles an actual environment as closely as possible." (Shulman, 1970, p. 383).

Simulation and Independent Study -- Simulation may be defined as an activity involving a decision maker seeking to achieve certain objectives in some limiting context and has been used extensively in science and more recently in education. As it is implemented in the methods course, simulation refers to the role of the teacher as a facilitator of learning experiences for others. It is reasonable to assume that a prospective teacher will perceive this role as facilitator more efficiently if he is required to organize a substantial portion of his own learning as opposed to following a recipe for learning, pre-organized (and perhaps pre-digested) for him by some external source.

The degree of reality, as it affects student assumption of the responsibility to assert himself, may be greatly increased if the traditional three-lectures-per-week format is replaced by some form of independent study. If time normally reserved for lectures is allocated for student - centered purposes, the total contact time extended by the instructor will not be increased, but the impact of his efforts may increase many fold. If students may be held responsible for conducting a portion of their own instruction, the instructor is free to do those things which are uniquely achieved more capably by him. It may be asked, "What sort of advantages accrue from this arrangement?"

Haywood, (1968) asserted that the benefits of independent study lie in the activation of the self-starting discipline, self-renewal, and self-realization. "At its best, independent study may succeed in substituting the excitement of discovery for the dull routine of passive assimilation, and the habits of exploration for those of mere navigation." (p. 280).

It follows rather naturally that if students are relieved of having to meet a rigorous class schedule on behalf of an instructor, the use of that normally-assigned time is likely to follow the priorities of the students. Furthermore, if students are different in their backgrounds and other aspects of readiness, it seems likely that the class time will be used in a variety of ways.

Consequently, self-pacing becomes a probably mode of operation. Self-pacing in turn forces each student to relinquish his passive student role and become assertive in generating his own learning. A professional assigned to guide the education of others certainly should be able to perform this function on his own behalf. If a student is expected to direct his own learning, he should be entitled to know the criteria demarking adequacy in this persuit and to understand how such criteria are established. The resultant advantage is a removal of much of the guesswork about successful course completion through the identification of concrete, executable competencies.

The availability of unscheduled class time permits the instructor to meet individual demands of the students through one-to-one and small group conferences initiated by the students themselves. He may assist the student in diagnosis and prescription, provide counsel, provide direction or information, or serve as a sounding board for expanding student ideas.

Through conferences the requirements for particular students may be adjusted drastically. For example, experienced teachers may focus more intensely on implementing a systems approach, whereas the inexperienced student may focus more on techniques for assuring class control. Meanwhile, foreign students may find it more valuable to investigate the application of new curricula and supervision techniques to their own educational systems.

In addition, students can exercise their skills in self-evaluation, diagnosis, and prescription. Finally and probably most important, this mode provides each

student a store of personal reactions to structured independent study which he may call forth in planning a similar mode for his own pupils in the future. Essentially, he has experienced instruction which deviates from the usual lock-step, expository tradition.

Proponents of the "tried and true" tradition may suspect the possibility of critical disadvantages in this looser course organization. In fact, Douglass (1968) has cited some pitfalls associated with individual instruction:

(1) students need help in organizing and managing their own time

(2) there may be inadequate mapping of the student's course

(3) all students do not possess instant readiness in goals, motivation and technical capabilities commensurate with self-actualization

(4) availability and coordination of resources may be a problem

(5) instruments for measuring student performance may be inadequate

(6) infrequent student-faculty contact may arise

(7) some students prefer the primrose path of monitored education.

The above concerns are countered by Wootten (1968) who suggested that students have more potential in some areas and less in others. It is not imperative that all students perform the same study operations nor gain the same values from each course. Furthermore, independent study provides the opportunity for guiding the student in identifying his own problems, plotting his own procedures for attacking those problems, seeking the solutions, utilizing all possible resources, and evaluating the outcomes. Wootten acknowledged that the key to this potential is effective guidance.

The instructors in the methods of science, of all disciplines, should be most receptive to the listed cited by Wootten. If nothing else, such a mode of operation should provide a model for the budding science teachers. Schwab (1960) recommended that science knowledge conveyed as empirical, literal, and irrevocable truth be replaced by an enquiring curriculum and classroom. The responsibility

of the teachers is, in this context, to impart to his students any art by means of which the student can teach himself. Hence, independent study constitutes a means by which methods teachers may exemplify an alternative to Schwab's "rhetoric of conclusions". Certain applicable models have been provided by Sund and Tillery (1969), Druger (1969), and Voelker (1970).

Description of the Course

In designing the methods course presently in operation at The Pennsylvania State University, an attempt was made to implement the above rationale in an operationally effective program. While some aspects of the course have changed over the year and a half that the course has been in operation (tinkering) the major features deemed most valuable will be described in the following pages.

The course is organized around the achievement of performance criteria following a mastery learning model. Although conditions for demonstrating competency are specified by the instructors, students select the means for developing the competencies and pace themselves according to their own schedule by completing formal learning contracts for their own requirement deadlines. Students are provided the option of replacing any or all of the requirements with their own alternatives, provided they can be spelled out behaviorally.[1] This arrangement, which might be called structured independent study (SIS) features no formal class meetings after the first two weeks of the ten-week term except for an examination period. The most exacting requirement demanded that the student videotape, code, and critique two teaching performances in terms of prescribed teaching behaviors. Coding was accomplished with the Social Substantive Schedule (Ribble and Schultz, 1970), which was designed to assess and communicate the idea of congruence between a specified instructional mode and a teacher's verbal behavior.

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[1]See Course Syllabus in the yellow pages of this document for the list of performance criteria.

Students also operated all machines, scheduled peers to serve as pupils for their teaching episodes, and initiated requests for activities or special seminars. Information was supplied in the form of hand-outs, including a glossary of working definitions, readings, and audio-tutorial modules. Thus most of the instructors' time was reserved for conferences initiated by students and for evaluating written work. Instructional marginal notes were employed liberally.

Before describing specific aspects of the course, it is appropriate to discuss the function of modeling in the methods course learning experience. Providing a Model - A major contribution of the course is to provide working models of examples of instructional strategies which are viable alternatives to the lecture-recitation model. In addition to the modelling function, the course provides a modest amount of instruction in how to function as a teacher in these different instructional modes.

Three concepts have been purposely modelled in these courses. Not mutually exclusive, they are structured independent study (SIS), performance criteria (PC), and mastery learning (ML).

SIS implies that the activities the learner will engage in, and the scheduling of such activities are spelled out with considerable detail at the beginning of the course. The learner is left to his own devices to use almost any methods, materials, sources, or individuals he feels he needs to complete the requirements according to the PC.

PC are specific behaviors (see yellow pages) or products of student behavior which the student must master for success in the course. For example, a student has to instruct a group of peers in some aspect of science such that his verbal behavior includes a minimum of 5 percent of teacher questions at a level considered higher than knowledge level. When a student has demonstrated his ability

to direct his behavior in the specified manner, he receives a satisfactory mark.

Mastery learning suggests that each learner be able to spend as much time as necessary within certain reasonable limits, to successfully meet the PC. Thus, if a student's behavioral objectives do not meet the four specified criteria for well-written objectives, the deficiency is communicated to the student who then has the option of reworking his offering and resubmitting it for the instructor's evaluation as often as is necessary.

A significant factor in the modeling procedure is that the student does more than just read about and discuss these modes; he actually experiences them and hopefully formulates and stores personal philosophies about the strengths and weaknesses of these experiences.

Technical Skills and Systematic Observation - Students are given instruction in the use of a systematic observation schedule to assess their own teaching performances and those of peers and experienced teachers. Ultimately each student performs two videotaped teaching sessions which he then analyzes with the use of the Social Substantive Schedule (Ribble and Schultz, 1970).

The Social Substantive Schedule is a verbal analysis system derived from the behaviors described by John Withall (1949) and Arno Bellack (1965). It is unique in that it (1) is easy to learn by novice observers, and (2) yields data which can be used for assessing and communicating the idea of congruence between a stated objective and a teacher's choice of behaviors to implement that objective. The latter advantage is especially useful in that it prescribes verbal behavior characteristic of inquiry as opposed to guided discovery, lecture-recitation, drill, and free-wheeling modes of instruction. The prescriptive element offers the student a yardstick by which he can measure the degree of success he has attained in meeting predetermined instructional behaviors.

An example of the prescribed verbal behavior compared the guided discovery

with the inquiry mode of verbal interaction in Table 1. An example of teacher pursuit would be when the teacher asks a student to verify or justify a previous assertion. According to these criteria, pursuit questions should not be frequent in the Guided Discovery mode, but must be present in the Inquiry mode.

Table 1

Criteria for Identifying the
Guided Discovery and Inquiry
Modes of Instruction

(Ribble and Schultz, 1970)

| Behavior | | Guided Discovery | Inquiry |
|---|---|---|---|
| Teacher | Agrees | ** | - |
| | Encourages | * | * |
| | Emphasizes | ** | * |
| | Translates | * | ** |
| | Elicits | ** | ** |
| | Checks | * | - |
| | Explores | * | * |
| | Pursues | - | ** |
| | Informs | ** | * |
| | Directs | - | -- |
| | Reproves | - | -- |
| | Sustains | - | - |
| Student | Complies | * | - |
| | Volunteers | * | ** |
| | Comments | * | * |
| | Questions | * | ** |

(**) must be present

(*) may be present

(-) should not be frequent

(--) must not be present

Although the distinctions between the presence and frequent expression of behavior may be arbitrary, the Social Substantive Schedule still provides

obvious directionality which the aspiring teacher is able to use along with coded feedback for self-correction.

Evaluation

Although there is a need to evaluate educational changes before proceeding on to new educational changes, the effects of innovation are highly elusive to the curriculum evaluator, and thus rarely is evaluation thorough.

Preliminary results from comparing students in the experimental methods course with students in a traditionally-organized (T-O) methods course hint of this elusiveness. The results do, however, strongly suggest the following:

(1) typical measures of course achievement (e.g., test scores, final grade, and number of incomplete assignments) were unable to discriminate between the two groups of students

(2) the estimate of time spent on the course made by the experimental group was significantly shorter than the time estimate made by the T-O students

(3) the experimental students exercised the option of conferring with the instructors significantly more often than the T-O students.

Thus, in spite of the fact that course achievement, as measured by conventional measures, yielded equivalent performance, the independent study group spent significantly less time and conferred more in individual conferences with the instructor than the students in the traditionally-organized methods course.

The most favorable activity, as rated by the students in the experimental and control groups was the evaluation of the videotape teaching performances.

Evidence of an unanticipated benefit of the course came from the graduate assistants who worked with the experimented course and contributed much to its development. These doctoral candidates, who will be moving into science teacher training positions in the near future, to a man stated that the experiences obtained from the course was an extremely valuable experience.

Future research efforts should be mounted to assess possible long-range effects of this mode of conducting methods courses. Performance during the student teaching phase of preparation should be monitored, and professional growth and competence assessed in the years after graduation. Hopefully, these teachers will engage in deliberate and calculated behaviors based on a rationale, and will monitor their own performance and achievement of their students to evaluate their own growth. And hopefully, this methods course will have played a significant part in that growth.

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